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FERNS OF MT. TOBY, MASSACHUSETTS.

MARIA L. OWEN.

THE description in RHODORA¹ of the delightful fern ravine in Thetford, Vermont, moves me to tell of our Western Massachusetts fern paradise. This is Mt. Toby, five or six miles north of Amherst, a favorite resort of botanists for other growths as well as ferns. Mr. Solomon Stebbins of Springfield tells me that within a circle not over two miles in diameter some fifty species and varieties of ferns (including some of the allied Adder's Tongue family) may be found, — the exact number hard to state on account of the varieties, for some of these are ill-defined and it is difficult to know whether to count them or not. The diversity of surface affords a suitable habitat for the rock and the wood ferns, those that love pasture, meadow, marsh or brookside, and so we have first, eighteen of the nineteen in the Thetford list, all common; but the nineteenth, *Aspidium aculeatum*, var. *Braunii*, does not grow in our State so far as known. *Cystopteris fragilis* and *Onoclea sensibilis* can always be found finely fruited. *Asplenium angustifolium*, though local, is abundant in spots, and *Aspidium acrostichoides*, var. *incisum*, not infrequent.

Mt. Toby gives us in addition the following: *Pellaea gracilis* grows in crevices, on shaded rocks and at the foot of dripping ledges, while *P. atropurpurea* can always be found on certain dry rocks, but is not so common. *Asplenium Trichomanes* and *A. ebeneum*, and a form of the latter with incised pinnae also occur, together with *A. Filix-foemina* and several variations — *Michauxii*, *rigidum*, *laciniatum* and *exile*, whether allowed as varieties or only forms. These grow

¹ Vol. ii, 229.

anywhere, but *A. Ruta-muraria* is scarce,— only one patch on rocks within this circle.

We find the Walking-leaf — to use Dr. Bigelow's English name for the *Camptosorus* — but a pretty habit that it has may be the death of it. Growing amongst mosses and other low plants that need but little depth of soil, and whose interlaced roots weave the whole together, it frequently carpets the flat tops of rocks,— a beautiful sight which draws the attention even of idle picnickers who, not realizing that they are destroying years of growth, find it amusing to peel off these mats and then, without a pitying thought, throw them on the ground to die. Thus they have laid bare the rocks within sight of their walks; but away from the paths the interesting fern is still common.

The three species of Phegopteris, *P. polypodioides*, *P. hexagonoptera* and *P. Dryopteris* are common; the Aspidiums, *A. Thelypteris*, *A. Noveboracense*, *A. spinulosum* with var. *intermedium* and *A. Boottii* are everywhere, while *A. cristatum*, var. *Clintonianum* is not so common. *Cystopteris bulbifera* edges the brooks and drapes the wet rocky banks with a luxuriant growth, the elegantly tapering fronds often three feet long, and the rhachis thickly set with bulblets. *Woodsia obtusa* is fairly common on rocks, but disappears as we go up and is replaced by *W. Ilvensis*. The three Osmundas grow wherever the situation suits them, and var. *frondosa* of *O. cinnanamea* may be found any year when there has been a late spring frost to check the development of the unrolling fronds;— so I am told by Dr. W. H. Chapin, who is, like Mr. Stebbins, very familiar with the mountain.

Of the Adder's Tongue family, first in interest is perhaps *Botrychium simplex*. One happy year Mr. Stebbins, with a friend's help, counted over eight hundred plants in a space ten rods by seven or eight in extent, and that after he had collected freely for pressing; it took sharp eyes to detect the delicate little things, but the census takers went down and crept on hands and knees as long as specimens showed themselves. A few came up in the same place the next year, but after that no more; still at the right season one who knows the mountain can find the plant in some spot. *B. Virginianum* grows in the woods, *B. ternatum* in its varieties *australe* and *intermedium* in the sugar orchards, and vars. *obliquum* and *dissectum* in pastures. *Ophioglossum vulgatum* comes up in solid clumps and then mysteriously disappears and has to be sought in some other place, but it is soon found.

This closes the list of Mt. Toby ferns. There are only five more in this part of the state, *Woodwardia Virginica* and *W. angustifolia*, *Lygodium palmatum*, *Botrychium matricariaefolium* and *B. lanceolatum*. We cannot credit our beloved mountain with these, but are well satisfied with the thirty-seven to fifty kinds — according to the number of varieties that one chooses to admit — which we can collect in one day within the sweep of our one mile radius. Our Mt. Toby plants are more scattered than those of the charming Vermont fern garden, and we have to work harder for them, but, considering their number and the rarity of some, we think our paradise worthy of a place in a botanist's heart, beside that other delightful spot.

SPRINGFIELD, MASSACHUSETTS.

THE NORTHEASTERN CARICES OF THE SUBSECTION VESICARIAE.

M. L. FERNALD.

THE species of *Carex* ordinarily referred to the *Vesicariae* have been, with the possible exception of the *Rigidae* and the *Ovales*, the source of our greatest difficulty in studying that genus in Eastern America. Nearly all the forms now known in our flora have been from time to time associated with two or more so-called species, a divergence of treatment readily seen between the first and the sixth editions of Gray's Manual. In the first edition Carey recognized as American species *C. vesicaria*, L. and *C. ampullacea*, Good., of Europe. In subsequent editions other European species of the group, *C. rotundata*, Wahl., and *C. pulla*, Good., were recognized as belonging to our flora. Gradually, however, the American plants which once passed under those names, have been set apart, one by one, as distinctively American species, and for the American *Carex vesicaria* we have *C. monile*, Tuck.; for our *C. ampullacea*, *C. utriculata*, Boott; for American *C. rotundata* and *pulla*, *C. miliaris*, Michx. A study of some recently collected material has convinced the writer, however, that there is little reason for separating many American plants from the Old World species which they represent.

Recent authors have recognized in eastern America three species of the *saxatilis* (*pulla*) group. Of these *C. oligosperma* and *C. compacta* are clearly marked and perhaps of purely American range.

The other plants have all been referred to *C. miliaris*, Michx., an American species.

The botanical party¹ which recently explored a portion of Mt. Katahdin in Maine found two species of this group growing about the ponds upon the lower slopes of the mountain. One of these, a low plant with broad flat leaves and small purple spikes of nerveless perigynia is exactly the *C. saxatilis*, L. (*C. pulla*, Good.) of northern Europe. The other, a taller plant with yellowish-green or brownish spikes of nerved perigynia, is a good match for the original material of *C. Grahmi*, Boott, of Scotland. Most of the Katahdin *C. saxatilis* is identical with the Hudson Bay plant so treated by Prof. Bailey, but a few plants found at a second station show the involute leaves characteristic of *C. miliaris*. Now by Carey and Gray and formerly by Prof. Bailey, *C. miliaris* was treated as a form of the European *C. saxatilis* (*C. pulla*), but recently Prof. Bailey has separated Michaux's *C. miliaris* as an American species taking for his distinctions the narrower leaves and paler narrower spikes of the latter plant. That the breadth of leaf is not constant is very apparent in specimens from Mt. Katahdin. The spike in good *C. miliaris* varies much in length and is often as short as in *C. saxatilis*, and the purple-brown perigynia of Robinson & Schrenk's Newfoundland plant (No. 87 — in all other points good *C. miliaris*) show that the color-character has little final value.

As already stated the taller plant growing by Depot Pond at the entrance to the Basins of Mt. Katahdin is *C. Grahmi* of Scotland. This very rare species was described by Francis Boott from material collected by Wight on cliffs at Glen Phee, Clova, and the Katahdin plant is apparently identical with the original material, with which it has been carefully compared. The American plant described by Prof. Bailey as *C. miliaris*, var. (?) *aurea*, ordinarily has slightly narrower spikes than the Glen Phee and Katahdin specimens of *C. Grahmi*, but most of the material of that form yet examined is immature. The perigynia, however, are inflated and nerved as in *C. Grahmi* so that little hesitation is felt in placing the plants with that species. It is doubtful, though, whether most of the Rocky Mountain specimens which have sometimes been referred to *C.*

¹J. R. Churchill, J. F. Collins, M. L. Fernald, G. G. Kennedy, and E. F. Williams.

Grahami are the same as the plant of Scotland and Northeastern America, a view already broached by Prof. Bailey.

Among the puzzling forms of this group collected by Messrs. A. H. & C. E. Smith at the outlet of Moosehead Lake was one plant which was doubtfully referred by Wm. Boott to *Carex rotundata*, Wahlenberg, of Scandinavia. The plant was so treated in the fifth edition of Gray's Manual, and in his Synopsis of the Genus *Carex*¹ Prof. Bailey interpreted it in a similar way. Subsequently, however, the American specimens have been referred by him to *C. miliaris*. *C. rotundata* of Wahlenberg has always been a little-known and poorly understood species. Much of the European material so named is referable to *C. saxatilis* and perhaps to our American *C. compacta*. In the Gray Herbarium there is, however, one sheet which may be taken as authentic. One of the specimens collected by Wahlenberg, himself, was sent by Francis Boott to his brother, William Boott. By these authors the specimen was accepted as authentic, as it was also by Olney who wrote upon the sheet "The plant from Wahl. just typical *C. rotundata*." A second specimen, from Greenland, is a perfect match for Wahlenberg's plant, and the Moosehead plant, though immature, is habitally like it, and the perigynia in their texture and nervation are essentially the same. It is still doubtful, however, whether the species is truly distinct from *C. saxatilis* and *C. miliaris*.

For many years the commonest form of the plant now passing as *Carex utriculata* was treated by both American and European authors as identical with the European *C. rostrata*, Stokes (*C. ampullacea*, Good.). Under the second of these purely synonymous names the plant was described by Carey in four editions of Gray's Manual. The plate of *C. ampullacea* in Francis Boott's great monograph was drawn from a Saskatchewan specimen, and Professor Bailey in 1886 treated the American and the European plants as identical. Subsequently, however, he maintained that the American plant is distinct from the European in its "grosser habit, lack of stoloniferous character, broader and proportionately shorter leaves, heavier and more scattered spikes, of which the lower are less peduncled, and much sharper scales."² A careful study of much material fails to convince the writer, however, that the medium-sized form of the Ameri-

¹ Proc. Am. Acad. xxii (1886), 67.

² Mem. Torr. Club, i. 60.

can plant (*C. utriculata*, var. *minor*, Boott) is in any way different from the European. In New England and adjacent Canada where the plant has been watched for some years the spikes vary extremely in size and compactness, and in these characters as well as in that of the scale the American plants are perfectly matched by the equally diverse European specimens. Professor Bailey's statement that the American plant is not stoloniferous cannot be founded upon study of carefully prepared material. It is true that most of the older herbarium specimens, hastily pulled up or broken off, show no stolons, but very many of recent collection, both in the Gray Herbarium and that of the New England Botanical Club, exhibit long stout stolons often a foot in length. This preservation of the stolons in the American specimens is doubtless due to the greater care exercised by recent botanists in the collection of their material. The original *Carex utriculata* of Boott is the coarsest form of the American plant, with perigynia often nearly 1 cm. long. As an extreme it is well marked but with many transitional specimens constantly occurring it cannot be maintained as a species and must be treated, as was done by Carey and formerly by Bailey, as a variety of the European species.

The plant described by Francis Boott as *Carex Olneyi* has been treated by Professor Bailey as a hybrid between *C. bullata* and *C. utriculata*. This view of the plant is based largely upon the fact that the Providence specimens are "sterile or nearly so." The same plant was collected abundantly by Wm. Boott in a swamp in eastern Massachusetts, and Mr. Canby gets it at different stations in Delaware. At these stations the plant though often sterile is no more so than is often the case in *C. utriculata* and various other species. These Carices being anemophilous must frequently be quite sterile, for, depending as they do upon gusts of wind to bring them pollen, large areas of the plant may readily remain unfertilized if the wind happens to take the pollen away from the colony, and especially if the plant is not a common one. Such sterile specimens of not only *C. Olneyi*, but *C. Grahamei*, *C. rostrata* and its var. *utriculata*, *C. bullata*, *C. monile*, and many other species are familiar to most botanists who know these plants in the field. The sterility of many specimens of *C. Olneyi* does not seem to the writer sufficient ground for treating it as a hybrid. Furthermore, the perigynia of this plant are smaller than are those of *C. bullata*, and if it be considered a hybrid we must

assume that its other parent is a plant with perigynia likewise smaller than in *C. bullata*. The only form of *C. utriculata* (as treated by Professor Bailey) which meets this demand is var. *minor*, Boott (*C. rostrata*, Stokes), which, as represented in the Gray Herbarium, seems to grow no further south than Connecticut. It hardly seems probable, then, that *C. Olneyi*, a plant occurring from eastern Massachusetts to Delaware, has any genetic affinity with *C. rostrata* (*C. utriculata* in part of Bailey). The species is, however, so close to *C. bullata* in its varying forms that it seems better treated merely as an extreme variation from that type.

In the first four editions of Gray's Manual Carey recognized *Carex vesicaria*, L., of Europe as an American plant and the plate of that species in Boott's Illustrations was drawn from an Ohio specimen. In the fifth edition of the Manual, however, Dewey's *C. Vaseyi* was taken up in its stead, a plant said to differ from the European *C. vesicaria* "in the more pointed scales and fewer-nerved perigynia tapering gradually into a longer beak." In 1886, however, Professor Bailey united with Tuckerman's *C. monile* the *C. Vaseyi* of Dewey, and since then the American plant which was long treated either as *C. vesicaria* or *C. Vaseyi* has passed as identical with Tuckerman's species. That the American *C. vesicaria* (*C. Vaseyi*) passes directly into *C. monile* there can be no doubt, but a study of European specimens from Francis Boott, Fries, Blytt, Hooker, and others shows no appreciable nor constant differences between the European and American plants. Furthermore good *C. monile* occurs in Transylvania at least, and a northern extreme of our American plant is well matched by *C. vesicaria*, var. *distenta*, Fries, of Scandinavia. *Carex Raeana*, Boott, a beautiful northern plant which apparently has been collected at only two stations, the original of Richardson near Methye Lake in Athabasca, and the shores of Lake St. John at the head of the Saguenay, is treated by Professor Bailey as a variety of *C. monile*. The typical *C. Raeana* is indeed very unlike the latter species, but Pres. Ezra Brainerd has collected at Lake St. John material which shows it to pass directly into typical *C. vesicaria*.

Carex Tuckermani, *C. bullata*, *C. retrorsa*, and *C. lurida* are apparently distinctive American plants, and their treatment is not obscured, like that of some of the species here discussed, by the rather scattered descriptions of European forms. *C. Tuckermani* and *C. bullata*

are tolerably constant in their tendencies, but *C. retrorsa* and *C. lurida* are excessively variable and present many puzzling forms. The treatment of them here adopted is essentially that already proposed by Professor Bailey.

In the preparation of the following synopsis the writer has been greatly assisted by Pres. Ezra Brainerd, who has kindly loaned his northern material of the group, and by Professor John Macoun, who has allowed the use of the extensive collections of the Geological Survey Department of Canada. These two collections have satisfactorily supplemented the representation in the Gray Herbarium and the herbarium of the New England Botanical Club.

SYNOPSIS OF SPECIES AND VARIETIES.

* Perigynium not bladder-like nor conspicuously inflated; the beak with an entire or short-toothed orifice.

+ Perigynium nerved.

++ Spikes few-flowered, loose: mature perigynium rather firm, 5 or 6 mm. long.

C. OLIGOSPERMA, Michx. Slender and tall (2.5 dm. or ^{mne} less high), with involute leaves: staminate spike usually 1; pistillate spikes 1 or 2, very rarely 3, at most 1.5 cm. long: the shining conic-ovoid perigynium ascending, nearly twice as long as the broad blunt purple-tipped scale.—Fl. ii. 174; Carey in Gray, Man. 567; Boott, Ill. i. 25, t. 63; Bailey, Proc. Am. Acad. xxii. 64, & Mem. Torr. Club, i. 64. *C. Okesiana*, Dewey, Sill. Jour. xiv. 351. *C. Despreauxii*, Steud. Syn. Pl. Cyp. 237 (acc. to Bailey, l. c. 69).—Bogs and wet shores, Labrador and Newfoundland to Pennsylvania, Minnesota, and the Saskatchewan.

++ ++ Spikes dense: perigynium smaller.

= Leaves flat.

a. Pistillate spike purplish: perigynium globose-ovoid, abruptly short-beaked, membranaceous, squarrose-spreading.

C. COMPACTA, R. Br. Rather stout, 2 to 4 dm. high: staminate spike 1 (rarely 2), short-peduncled; pistillate spikes 1 or 2, very dense, sessile, erect, 1 to 3 cm. long, 7 to 9 mm. thick.—R. Br. in Ross, Voy. App. cxliii (nomen nudum), & in Dewey, Am. Jour. Sci. xxvii. 237, t. U, fig. 63; Boott, Ill. iv. 156, t. 502; Bailey, Proc. Am. Acad. xxii. 66, in part, & Mem. Torr. Club, i. 39. *C. membranacea*, Hook. in Parry, 2nd Voy. App. 406; Dewey, Am. Jour. Sci. xxix, 247, t. X, fig. 73. *C. saxatilis*, var. *compacta*, Dewey, Am. Jour. Sci. xi. 310. *C. membranopacta*, Bailey, Bull. Torr. Club. xx.

428. — Baffin Land (*Capt. John Ross*) and Northern Labrador (*Turner*) to Great Bear Lake (*Richardson*): perhaps also in northern Europe.

- b. Pistillate spike yellow-green or merely purple-tinged: perigynium ovate, tapering gradually to the longer beak, ascending (*C. monile*, var. *Raeana* might be looked for here).

C. GRAHAMI, Boott. Rather tall (4 to 7 dm.) and slender: staminate spikes 1 or 2, peduncled; pistillate spikes 1 or 2 (rarely 3), the lowest mostly short-pedicelled, slightly spreading or ascending, 1 to 3 cm. long, 6 to 9 mm. thick: perigynium submembranaceous, few-nerved, 4 or 5 mm. long, twice as long as the blunt or acute ovate pale or purple-tinged scale. — Trans. Linn. Soc. xix. 215; Syme, Eng. Bot. x. 172, t. 1684; A. Bennett, Jour. Bot. xxxv. 263. *C. saxatilis*, L., var. *Grahami*, Hook. & Arn. Brit. Fl. ed. 8, 510; Bailey, Mem. Torr. Club, i. 38, in part. *C. pulla*, Gray, Man. ed. 5, 602, not Good. *C. miliaris*, Michx., var. ? *aurea*, Bailey, l. c. 37. *C. Raeana*, Britton & Brown, Ill. Fl. i. 295, fig. 682, not Boott. — Shores and marshy ground, NEWFOUNDLAND, Exploits River (*Robinson & Schrenk*, no. 236): QUEBEC, East Main River (*A. H. D. Ross*); Lake St. John (*G. G. Kennedy, E. Brainerd*): NOVA SCOTIA, North Ingonish, Cape Breton (*J. Macoun*, Herb. Geol. Surv. Dept. Can. no. 20,838): NEW BRUNSWICK, Kennebeckasis (*J. Fowler*): ONTARIO, Chaudiere Falls, Ottawa (*Macoun*, Herb. Geol. Surv. Dept. Can. no. 7438, in part): MAINE, margin of Depot Pond, entrance to Basins of Mt. Katahdin (*J. R. Churchill, E. F. Williams & M. L. Fernald*); outlet of Moosehead Lake (*A. H. & C. E. Smith*): BRITISH COLUMBIA, Donald, Columbia Valley (*John Macoun*): SCOTLAND, Glen Phee, Clova (*Wight*); and reported from a station in Perth.

= = Leaves soon becoming involute.

C. ROTUNDATA, Wahlb. Rather slender, 6 dm. or less high: staminate spike 1 (rarely 2 or 3), short-peduncled; pistillate spikes 1 or 2, sessile, short and compact, 8 to 13 mm. long, 6 to 8 mm. wide, the lower subtended by a divergent or somewhat ascending bract 4 or 5 cm. long: perigynium pale or ferrugineous, plump, membranaceous, few-nerved, subglobose-ovate, about 3 mm. long, tapering abruptly to the very short subentire or short-toothed beak, one half longer than the ovate purplish scale. — Act. Holm. 1803, 153, & Fl. Lap. 235; Gray, Man. ed. 5, 602; Bailey, Proc. Am. Acad. xxii. 67, in part, & Mem. Torr. Club, i. 39. — This name has been applied to numerous plants which are very different from the original plant of Wahlenberg. A specimen in the Gray Herbarium collected by Wahlenberg, himself, described above, and matched by a Greenland plant (*Warming & Holm*), is essentially the plant from MAINE, outlet of Moosehead Lake, Aug. 24, 1867 (*C. E. Smith*). A specimen from the upper Mackenzie (*Tyrrell*) is probably the same.

+ + Perigynium nerveless (or faintly nerved in exceptional specimens of var. *miliaris*).

C. SAXATILIS, L. Low (2 or 3 dm. high) with flat leaves, 0.5 cm. or less wide, nearly or quite equalling the culm: staminate spike 1 (rarely 2), short-peduncled or subsessile; pistillate spikes purplish, 1 to 3, sessile or the lowest short-peduncled, subglobose or short-oblong, 0.5 to 2 cm. long, 5 to 8 mm. thick: perigynium purplish or purple-tinged, usually nerveless, ovate, 3 or 4 mm. long, tapering gradually to a short subentire beak, slightly longer than the acutish or blunt purple scale: stigmas usually 2. — Sp. 976; Bailey, Proc. Am. Acad. xxii. 65, & Mem. Torr. Club, i. 37. *C. pulla*, Good. Trans. Linn. Soc. iii. 78, t. 14; Smith, Eng. Bot. xxix. t. 2045; Fl. Dan. xvi. t. 2850. — Northern Europe and Greenland: HUDSON BAY, North and South Twin Islands (*J. M. Macoun*): UNGAVA, Prince George's Sound (*R. Bell*, Herb. Geol. Surv. Dept. Can. no. 18, 795); Ungava River (*Spreadborough*, Herb. Geol. Surv. Dept. Can. no. 13,605): LABRADOR, Battle Harbor (*A. C. Waghorne*): MAINE, margin of pond, Chimney Basin, Mt. Katahdin, alt. 925 m. (*J. R. Churchill, E. F. Williams & M. L. Fernald*).

Var. *MILIARIS*, Bailey. Slender and taller, 2.5 to 6 dm. high: leaves nearly filiform: pistillate spikes mostly paler and more slender, 1 to 2.5 cm. long, 3 to 7 mm. thick. — Bot. Gaz. ix. 120, & Proc. Am. Acad. xxii. 66. *C. miliaris*, Michx. Fl. ii. 174; Boott, Ill. i. 73, t. 200, fig. 2; Bailey, Mem. Torr. Club, i. 35 & in Gray, Man. ed. 6, 593. *C. pulla*, Good., var.? *miliaris*, Gray, Man. ed. 5, 602. *C. miliaris*, var. *obtus*a, Bailey, Mem. Torr. Club, i. 36. — Margins of rivers and lakes from Central Maine northward, rare. NEWFOUNDLAND (*La Pylaie*); Exploits River (*Robinson & Schrenk*, no. 87); Grand Lake & Coal River (*A. C. Waghorne*, nos. 20, 23): QUEBEC, East Main River (*A. H. D. Ross*); Lake St. John (*A. H. Smith, G. G. Kennedy, Ezra Brainerd*): NEW BRUNSWICK, Rothsay & Richibucto (*J. Fowler*); Drury's Cove, St. John (*Wm. Boott*): MAINE, outlet of Moosehead Lake (*A. H. & C. E. Smith*).

Var. *rhomalea*. Coarser throughout than the last, mostly taller: the stouter culm rather thick at base: the coarser leaves involute: spikes mostly thicker and longer. — *C. miliaris*, var. *major*, Bailey, Mem. Torr. Club, i. 36. — LABRADOR (*Turner*); Seal Lake (*Spreadborough*, Herb. Geol. Surv. Can. no. 13,481): QUEBEC, Jupiter River, Anticosti (*J. Macoun*); Lake Mistassini (*J. M. Macoun*): MAINE, outlet of Moosehead Lake (*T. C. Porter*).

* * Perigynium turgid, often bladder-like; the beak sharply bidentate.

+ Scales smooth or only the lowest serrulate.

++ Perigynium turgid, but not conspicuously bladder-like: culm thick and spongy at base, generally smooth and bluntly angled above: leaves prominently nodulose.

C. ROSTRATA, Stokes. Culm 0.3 to 1 m. high, rather stout: leaves elongated, flat, usually equalling or exceeding the culms, pale green or glaucous, 0.2 to 1 cm. wide: staminate inflorescence mostly peduncled, of 2 to 4 distinct spikes; pistillate spikes mostly 2 to 4, sessile or the lower peduncled, cylindric, dense, 2 to 10 cm. long, 6 to 12 mm. thick: perigynium ascending or slightly spreading, ovate, flask-shaped, 3 to 6 mm. long, rather abruptly contracted to the cylindric beak, somewhat exceeding the bluntish or acute oblong or lanceolate purple-tinged scale. — Stokes in With. Arrang. Brit. Pl. ed. 2, 1059; Bailey, Proc. Am. Acad. xxii. 67, & Mem. Torr. Club, i. 59. *C. ampullacea*, Good. Trans. Linn. Soc. ii. 207; Eng. Bot. xi. t. 780; Fl. Dan. xiii. t. 2248; Reichenb. Ic. Fl. Germ. viii. t. 277; Carey in Gray, Man. 566; Boott. Ill. iv. t. 501. *C. utriculata*, Boott, var. *minor*, Boott, Ill. i. 14; Bailey, Mem. Torr. Club, i. 60, & in Gray, Man. ed. 6, 594. — Very wet swamps and in shallow water, Newfoundland and Labrador to Connecticut, New York, Illinois, the Saskatchewan and Vancouver, south in the mountains to Utah and California: Europe.

Var. *UTRICULATA*, Bailey. Coarser; the mature spikes 1 to 2 cm. thick, often longer than in the species: perigynium elliptic-ovate to oblong, 0.5 to 1 cm. long, tapering gradually to the beak. — Proc. Am. Acad. xxii. 67. *C. utriculata*, Boott in Hook. Fl. Bor.-Am. ii. 221, & Ill. i. 14, t. 39; Gray, Man. ed. 5, 600, in part; Bailey in Gray, Man. ed. 6, 594, in part; Britton & Brown, Ill. Fl. i. 297, in part. *C. ampullacea*, Good., var. *utriculata*, Carey in Gray, Man. 566. — Newfoundland to New Jersey, Ohio, and the Saskatchewan; in the Rocky Mountains to Utah, and on the Pacific Slope.

Var. *ambigens*. Very slender, 3 to 5 dm. high, culms barely 1 mm. in diameter below the spikes: leaves 2 to 5 mm. wide: staminate spikes 1 or 2; pistillate 1 to 3, globose or short-oblong, 1 to 2.5 cm. long: perigynium as in the species. — NEW BRUNSWICK, South Tobique Lakes, July 18, 1900 (*G. U. Hay*, no. 41): MAINE, sandy shore of St. John River, St. Francis, June 18, 1898 (*M. L. Fernald*, nos. 2076, 2077). Habitally resembling *C. monile*, but with the stiffer habit, spongy culms smooth and bluntly angled above, the nodulose leaves and the perigynia of *C. rostrata*.

++ ++ Perigynium bladder-like (except in *C. vesicaria*, var. *Raeana*): culm comparatively slender, sharp-angled above, often harsh: leaves slightly or not at all nodulose.

= Beak of the perigynium usually slightly roughened or serrulate (see exceptional specimens of *C. retrorsa*).

C. BULLATA, Schkuhr. Extremely slender, 7 dm. or less high, the long leaves 2 to 4 mm. wide: staminate spikes mostly 2 or 3, long-peduncled; pistillate spike 1 (or if 2, remote), globose or thick-cylindric, 1 to 4 cm. long, 1.5 to 2 cm. thick, rather loosely flowered:

perigynium strongly nerved, firm and shining, orbicular to ovate, very turgid, 6 to 9 mm. long, contracted to a slender conic-cylindric short-toothed beak, spreading and much exceeding the acute or bluntish scale. — Riedgr. Nachtr. 85, t. Uuu. fig. 166; Carey in Gray Man. 566; Boott, Ill. i. 15, t. 41; Bailey, Proc. Am. Acad. xxii. 68. *C. cylindrica*, Schw. acc. to Boott, l. c. *C. Greenii*, Boeckeler, Flora, 1858, 649. — Swales and wet meadows, Southern Maine to Pennsylvania and So. Carolina. Occasionally smooth-beaked specimens occur but these can be distinguished from *C. Tuckermani* by the firm texture of the perigynium and its peculiar yellow-green color.

Var. **Olneyi**. Coarser, the leaves 4 to 6 mm. wide: pistillate spikes mostly 2, cylindric, more densely flowered, 2.5 to 5 cm. long, 1 to 1.5 cm. thick: perigynium duller, more ascending and smaller than in the species. — *C. Olneyi*, Boott, Ill. i. 15, t. 42; Gray, Man. ed. 3, xcvi. *C. bullata* × *utriculata*, Bailey, Proc. Am. Acad. xxii. 68, & in Gray, Man. ed. 6, 595. *C. monile*, Britton, Bull. Torr. Club, xxii. 221, not Tuck. — Massachusetts to Delaware. MASSACHUSETTS, Tophet Swamp, Lexington, (*Wm. Boott*); Southbridge (*R. M. Harper*): RHODE ISLAND, Providence (*S. T. Olney*): DELAWARE, Blackbird and Townsend (*W. M. Canby*).

C. LUPULINA × **BULLATA**, Fernald. Coarse as in *C. lupulina*: pistillate spikes 3 cm. broad: perigynium firm as in *C. bullata*, but large and dull as in *C. lupulina*. — Rhodora, ii. 170. — MASSACHUSETTS, Medford (*Wm. Boott*).

= = Beak of perigynium smooth (rarely a little serrulate in *C. retrorsa*).

a. Mature perigynium 5 to 6.5 mm. thick.

C. TUCKERMANI, Dewey. Culms slender, 1 m. or less long, forming loose stools: leaves 3 to 5 mm. wide, the bracts very leaf-like and usually much exceeding the culm: staminate spikes 2 or 3, long-peduncled; pistillate 2 or 3, slender-peduncled or the upper sessile, cylindric-oblong, 2 to 6 cm. long, 1.2 to 1.8 cm. thick, loosely flowered: perigynium glossy, extremely membranaceous and bladder-like, strongly nerved, globose-ovate, 1 cm. long, tapering gradually to the slender cylindric beak, much exceeding the oblong-ovate acute or acuminate scale. — Am. Jour. Sci. xlix. 48, fig. 117; Boott, Trans. Linn. Soc. xx. 115, & Ill. i. 15, t. 40; Gray, Man. ed. 5, 601; Bailey, Proc. Am. Acad. l. c. & Mem. Torr. Club, i. 72. *C. bullata*, Dewey, Am. Jour. Sci. ix. 71, not Schkuhr. *C. cylindrica*, Carey in Gray, Man. 566. — Rich alluvium, New Brunswick, Maine, the White Mountains, and the Connecticut Valley to New Jersey, Indiana, Minnesota, Ontario and Lake St. John, Quebec.

b. Mature perigynium not more than 4 mm. thick.

1. Perigynium ascending, straight (*C. retrorsa*, var. *Macounii* may be looked for here).

C. VESICARIA, L. Comparatively slender, 0.4 to 1 m. high, the

culms sharply angled and generally roughish above, usually overtopped by the bracts: leaves 4 to 7 mm. wide, loosely ascending or spreading, but of firm texture: staminate spikes mostly 2 or 3, peduncled; pistillate spikes 2 (rarely 1) or 3, remote, sessile or short-peduncled, cylindric, 2 to 7 cm. long, 1 to 1.5 cm. thick: perigynium slightly turgid, ovate- to oblong-conic, tapering gradually to the slender beak, when mature 7 to 9 mm. long, twice exceeding the ovate-lanceolate acute or acuminate scale. — Sp. 979; Fl. Dan. iv. t. 647; Eng. Bot. xi. t. 779; Reichenb. Ic. Fl. Germ. viii. t. 276; Carey in Gray, Man. 565; Boott, Ill. iv. t. 536. *C. monile*, Dewey, Am. Jour. Sci. xlix. 47, fig. 116; Bailey, Proc. Am. Acad. xxii. 67, & in Gray, Man. ed. 6, 594, in part; not Tuck. *C. sp.* Boott, Ill. i. 28. *C. vesicaria*, var. *cylindrica*, Dewey, l. c. as syn. *C. Vaseyi*, Dewey, l. c. ser. 2, xxix. 347; Gray, Man. ed. 5, 600. — A common Old World species; less common in America. QUEBEC, Lake St. John (*E. Brainerd*): MAINE, Mechanic Falls (*J. A. Allen*): NEW HAMPSHIRE, Franconia (*E. & C. E. Faxon*): VERMONT, Middlebury (*E. Brainerd*): MASSACHUSETTS, Medford (*Wm. Boott*): Dedham (*Wm. Boott, H. A. Young*): RHODE ISLAND, Seekonk River (*S. T. Olney*): CONNECTICUT, Plainville (*C. Wright*): Southington (*C. H. Bissell*): NEW YORK, Pen Yan (*H. P. Sartwell*, exsic. no. 152, etc.): PENNSYLVANIA, Huntingdon Co. (*T. C. Porter*): OHIO (vide Boott, Ill. t. 536): ONTARIO, Ottawa (*Wm. Scott*): Nipigon River (*J. Macoun*): also in the northwestern states in various forms.¹

Var. **monile**. Leaves 2 to 5 mm. wide: pistillate spikes similar: the perigynium more turgid, roundish-ovate, about 6 mm. long, rather abruptly tapering to the beak. — *C. monile*, Tuck. Enum. Meth. 20; Carey in Gray, Man. 565; Boott, Ill. i. 28, t. 72; Bailey, Proc. Am. Acad. l. c. & Mem. Torr. Club, i. 39. — Meadows and low ground, Newfoundland to the Saskatchewan, Kentucky and Missouri; also Transylvania at Csik (*Barth*).

Var. **jejuna**. Smaller and more slender; leaves mostly 3 mm. wide: pistillate spikes thinner, 5 to 8 mm. thick: perigynium as in the last, 4 or 5 mm. long. — *C. monile*, var. *minor*, Olney in herb.; Bennett, Pl. Rhode Isl. 50 (as *nomen nudum*). — QUEBEC, Lakes Edward and St. John, Aug. 1896 (*E. Brainerd*): NEW BRUNSWICK, South Tobique Lakes, July 18, 1900 (*G. U. Hay*, no. 57): MAINE, St. Francis, June 18, 1898 (*M. L. Fernald*, no. 2075); Madawaska Lake, Aug. 2, 1900 (*E. F. Williams*): NEW HAMPSHIRE, North

¹ Although the West-American forms of the group are not specially discussed in this paper it is worthy of note that Brewer's no. 1654 from the Yosemite Valley is exactly *C. vesicaria*, var. *latifolia*, Blytt, Norg, Fl. i. 252, one of Blytt's original specimens matching the Californian material in every detail. Superficially the plant resembles *C. rostrata*, var. *utriculata*, but it has the sharply angled harsh culm of *C. vesicaria*.

Conway, Aug. 27, 1855 (*Wm. Boott*); Echo Lake, North Conway, June 8, 1878, near Gate of the Notch, July 7, 1878, and between Bethlehem and Fabyans, July 5, 1879 (*E. & C. E. Faxon*): VERMONT, Island Pond, July 4, 1854 (*Wm. Boott*); Gardner's Island, Lake Champlain, June 26, 1877 (*C. G. Pringle*); E. Wallingford and Bloomfield, 1899 (*W. W. Eggleston*, nos. 1659, 1667): MASSACHUSETTS, Framingham, July 7, 1897 (*E. C. Smith*, no. 653): RHODE ISLAND, banks of Seekonk River, June 15, 24, 1867 (*S. T. Olney*): CONNECTICUT, Hartford, June, 1879 (*C. Wright*): NEW YORK, Sand Lake (*C. H. Peck*); Raquette Falls, July 11, 1899 (*Rowlee, Wiegand, & Hastings*): ONTARIO, Nipigon River, July 22, 1884 (*J. Macoun*).

Var. *DISTENTA*, Fries. Nearly as slender as the last: pistillate spikes 1 or 2, short and thick, 1 to 2.5 cm. long, 1 to 1.3 cm. thick: perigynium as in var. *monile*.—Herbar. norm. Fasc. 15, no. 84, acc. to Blytt, Norg. Fl. i. 253. *C. Friesii*, Blytt, l. c.—NORWAY (*Blytt*): UNGAVA, along Ungava River (*Spreadborough*, Herb. Geol. Surv. Dept. Can. no. 13,647): NEWFOUNDLAND, Exploits River, with *C. saxatilis*, var. *miliaris* and *C. Grahmi*, Aug. 13, 1894 (*Robinson & Schrenk*); Grand Lake (*Waghorne*): QUEBEC, Rupert River (*J. M. Macoun*, Herb. Geol. Surv. Can. no. 20,241): MAINE, outlet of Moosehead Lake (*E. & C. E. Faxon*); Orono (*M. L. Fernald*). Closely resembling *C. Grahmi*, but in its acute scale and sharply long-toothed beak clearly an extreme of *C. vesicaria*.

Var. *Raeana*. Very slender, 4 to 6 dm. high: leaves 2 mm. wide, tending to become involute at tip: pistillate spikes very slender, at most 3 or 4 cm. long, 4 to 8 mm. wide: perigynium scarcely at all inflated, oblong-ovate to oblong-lanceolate, tapering gradually to the beak, 4 to 6 mm. long, one-third longer than the acuminate scale.—*C. Raeana*, Boott, in Rich. Arct. Exped. ii. 344, & Ill. i. 25, t. 64; Bailey, Proc. Am. Acad. xxii. 65, in part. *C. monile*, var. *Raeana*, Bailey, Mem. Torr. Club, i. 39.—ATHABASCA, Methye Portage, Methye Lake [Lac la Loche] (*Sir John Richardson*): QUEBEC, Roberval, Lake St. John, Aug. 22, 24, 1896 (*Ezra Brainerd*).

2. Perigynium retrorse or wide spreading (ascending in var. *Macounii*), slightly falcate.

C. RETRORSA, Schwein. Rather stouter than the last species, 1 m. or less high: leaves ribbon-like, of very soft texture, mostly 0.5 to 1 cm. wide; the bracts very much overtopping the culm: staminate spikes 1 to 4, sessile or short-peduncled, often pistillate at base; pistillate spikes 3 to 8, mostly clustered at the tip, sessile or short-peduncled, spreading, or the lower long-peduncled and remote, frequently compound, 1.5 to 5 cm. long, 1.5 to 2 cm. thick: perigynium very thin and soft, reflexed, conic-ovate, long-beaked, 8 to 10 mm. long, much exceeding the acuminate scale.—Ann. Lyc. N. Y. i. 71; Schw. & Torr. Ann. Lyc. N. Y. i. 366, t. 28, fig. 2; Carey in Gray, Man. 565; Boott, Ill. ii. 93, t. 276; Bailey, Proc. Am. Acad. xxii. 68, &

in Gray. Man. ed. 6, 595. *C. reversa*, Spreng. Syst. iii. 827. — Wet places, Gulf of St. Lawrence to the Saskatchewan and British Columbia, south to Pennsylvania, Michigan, Idaho and Oregon.

Var. *HARTII*, Gray. Pistillate spikes scattered, long-peduncled: perigynia mostly wide-spreading. — Man. ed. 5, 600; Bailey, Proc. Am. Acad. 1. c. *C. Hartii*, & var. *Bradleyi*, Dewey, Am. Jour. Sci. ser. 2, xli. 226. — Rather local, NEW HAMPSHIRE, Jackson (*Wm. Boott*): VERMONT, Pomfret, (*A. P. Morgan*): NEW YORK, Jefferson Co. (*Crawe*); Dundee, Yates Co. (*S. Hart Wright*); Greece (*S. D. Bradley*): ONTARIO, Seymour and Stirling (*J. Macoun*): MICHIGAN, Agricultural College (*C. F. Wheeler*); Lansing (*L. H. Bailey*).

Var. *Macounii*. Similar to the latter, but perigynia ascending. — *C. Macounii*, Dewey, 1. c. 228. *C. lupulina*, var. *gigantoidea*, Dewey, 1. c. 328. *C. lurida* × *retrorsa*, Bailey, Bot. Gaz. xiii. 88. *C. lupulina* × *retrorsa*, Dudley, Cayuga Fl. 119. — NEW YORK (fide *Dudley*, 1. c.): ONTARIO, Seymour, Northumberland Co., July 15, 1865, July 16, 1867, July 15, 1873, and Belleville, July, 1866 (*J. Macoun*): MICHIGAN, Alma, Aug. 20, 1893 (*C. A. Davis*).

C. RETRORSA × *UTRICULATA*, Fernald. Spikes and perigynia as in *C. rostrata*, var. *utriculata*, but the latter strongly retrorse. — *Rhodora*, ii. 170. — CONNECTICUT (*C. Wright*).

+ + Scales mostly with thin serrulate awns.

C. LURIDA, Wahl. Culms mostly smooth and obtusely angled, 1 m. or less high: leaves loose, scabrous, broad and flat, 4 to 6 mm. wide; the bracts leaf-like, elongated: staminate spike usually 1, elongated, peduncled or sessile, commonly subtended by a very narrow bract; pistillate spikes 2 or 3 (rarely 4), subapproximate, the upper subsessile, the lower short-peduncled and when more than 2 somewhat remote, very comose, oblong-cylindric, mostly 3 to 6 cm. long, 1.5 to 2 cm. thick: perigynium very thin and bladder-like, about 10-nerved, globose-ovate, 7 to 10 mm. long, the body barely equalling the slender long-conic beak. — König. Acad. Hand. xxiv. 153 (1803), fide Bailey, Mem. Torr. Club, i. 10, 11. *C. tentaculata*, Muhl. in Willd. Spec. iv. 266; Schk. Riedgr. Nachtr. 53, t. Ggg. fig. 130; Carey in Gray, Man. 563; Boott, Ill. ii. 94, t. 277; Bailey, Proc. Am. Acad. xxii. 69. *C. rostrata*, Willd. Spec. iv. 282; Schk. 1. c. 54, t. Hhh. fig. 134; not Stokes. *C. tentaculata*, var. *rostrata*, Pursh, Fl. i. 41. *C. gigantea*, Kunth, Enum. ii. 503 (fide Bailey). *C. Purshii*, Olney, Exsicc. fasc. i. no. 30. *C. Beyrichiana*, Boeckel. Linnaea, xli. 239 (fide Bailey). — A very common species in low ground, Annapolis Co., Nova Scotia, and Queens Co., New Brunswick to Ontario, Georgia, Louisiana, and Texas. Passing by numerous transitions to several formal varieties: —

Var. *EXUDANS*, Bailey. Spikes far apart, the lower very remote on elongated capillary peduncles. — Bailey in Britton & Brown, Ill. Fl. i. 299. — Range of species.

Var. *FLACCIDA*, Bailey. Spikes rather crowded at the tip of the culm, none remote, usually more ascending and less comose than in the species. — Mem. Torr. Club, i. 73. — Range of species.

Var. *PARVULA*, Bailey. Most of the spikes subglobose or short-oblong, 1 or 2 cm. long. — Bull. Torr. Club, xx. 418. *C. tentaculata*, var. *parvula*, Paine, Cat. Pl. Oneida, 105. — Range of species.

Var. *GRACILIS*, Bailey. The most slender form: leaves 2 or 3 mm. wide: spikes as in the species, but more slender, 1 to 4 cm. long, 1 to 1.3 cm. broad: perigynium 5 to 7 mm. long. — Mem. Torr. Club, i. 11, & in Gray, Man. ed. 6, 595. *C. tentaculata*, var. *gracilis*, Boott, Ill. ii. 94; Bailey, Proc. Am. Acad. l. c. *C. Baileyi*, Britton, Bull. Torr. Club, xxii. 220, & in Britton & Brown, l. c. fig. 694. — Mostly in mountainous regions, MAINE, east base of Mt. Katahdin and at Farmington (*M. L. Fernald*): NEW HAMPSHIRE, Franconia (*Wm. Boott*): VERMONT, Lake Dunmore, etc. (*A. W. Chapman*); Willoughby Lake (*Wm. Boott* etc.); Underhill (*G. G. Kennedy*); Smugglers Notch (*Churchill*, etc.); Waterbury and Ripton (*E. Brainerd*); No. Pomfret (*A. P. Morgan*); Townshend (*L. H. Bailey*): PENNSYLVANIA Delaware Water Gap (*Wm. Boott*): reported from the Southern Alleghanies.

C. LURIDA × *LUPULINA*, Bailey. Spikes subapproximate, 2 to 2.5 cm. broad: perigynium ascending, ovate-conic, about 18-nerved, 1 to 1.2 cm. long. — Mem. Torr. Club, i. 73, & in Gray, Man. ed. 6, 595. *C. tentaculata*, var. *rostrata*, Sartwell, exsicc. no. 138. *C. tentaculata*, ? var. *altior*, Boott, Ill. ii. 94, t. 278. *C. tentaculata* × *lurida*, Bailey, Proc. Am. Acad. l. c. 69, in part. — MASSACHUSETTS, Medford (*Wm. Boott*); Amherst (*E. Tuckerman*): CONNECTICUT, Groton (*C. B. Graves*); Wethersfield (*C. Wright*, acc. to Bailey): NEW YORK, Pen Yan, (*Sartwell*, no. 138). Sartwell's specimens have some good achenes, and the plant, though of hybrid origin, may now be a fertile form.

C. SCHWEINITZII, Dewey, in habit closely approaches slender-spiked forms of *C. rostrata*, and in its scales it is very close to *C. lurida*. Its perigynia are slightly inflated, in this also approaching the *Vesicariae*, but they are strongly costate as in the *Pseudocyperae*, and the plant is best treated, for the present at least, as a transitional species between these two groups.

GRAY HERBARIUM.

RAISING MUSHROOMS IN A CELLAR.

JOSEPH TORREY, JR.

IN 1897 and 1898 I undertook to cultivate mushrooms in my cellar. I had good success; and it has been suggested that my experience may be helpful to others who are desirous of making experiments in this direction.

My first bed was six feet long by four feet wide. The materials used in its construction were two barrels of horse manure, two and one half barrels of fresh loam and three bricks of mushroom spawn. The bed was constructed as follows: The manure, which had been carefully gathered so as to be as free as possible from straw, was spread out in the basement of a barn near by, and allowed to "heat," or ferment. Each day it was turned and left in form of a long "windrow." This was kept up till the man reported that the manure was nearly through heating. It was then brought into the cellar, after having been gone over once more to get out the last pieces of straw, and mixed up carefully with its own bulk of loam, care being taken that no lumps should remain, and that the whole mixture should be smooth and uniform. A layer of this mixture was then laid on the cement floor of the cellar and tramped or beaten into a firm mass about three inches deep. Another layer was now put down and the process continued till the bed was about ten inches deep. After standing for a few hours the bed had, as I found by making a hole down through it, about the same temperature as my hand, and this is about the right temperature for spawning. The second year I had to wait a day before the temperature came down to this point, but I am sure I could manage, with my past experience, to judge the condition of the manure in the windrow so that when it was put in the bed it would be ready to spawn at once, and I think anyone could. To spawn the bed, the spawn was cut into pieces about the size of a small egg, and each piece was put into a hole about four inches deep, and carefully covered with the manure-loam mixture. The holes were about eight inches apart as nearly as I can remember, at all events there were about sixty holes. I left the bed in this condition over night. The next day I put on four inches of loam and beat it down into a fairly compact form — not nearly so compact, however, as the underpart of the bed.

This was all the attention I gave it, except that once in a while during the next six weeks I moistened the surface with water at about the temperature of my hand, using a watering pot, and trying to use about as much water as would fall on that amount of surface in a moderate summer shower. I cannot say how many times this was done for I kept no notes, but not more than three or four at the most.

Mushrooms appeared in about six and a half weeks and the bed continued to bear for about four weeks. At the end of that time I put on four inches more loam, when the bed started up again and bore for about a fortnight longer.

I cannot give any figures as to the quantity of mushrooms gathered. It may seem strange that no notes were kept, but the fact is I did not enter upon the undertaking in any scientific way, and was not disposed to give much care or thought to it; but I thought it would be worth while to see whether the cultivation of mushrooms in a cellar was a difficult or an easy process. If it had proved difficult I should have dropped it at once. All I can say, then, is that there were mushrooms every day and sometimes they were gathered three times a day. They were large, fleshy, and of good flavor. No trace of any other kind of fungus appeared from first to last.

As to the difficulty, I never encountered it. Of course it may be I was especially favored by good fortune, but the fact that the same processes repeated the next year yielded practically identical results seem to show that there is no difficulty about it, at least on a small scale. It is more than probable that when carried on continuously and on the large scale complications would arise, and I should hesitate myself to undertake it without much more careful study than I have ever given to the subject.

The question is often raised whether the odor from the bed is noticeable. In my experiments there was no odor whatever from first to last. None could be detected even at the surface of the finished bed except the odor of mushrooms after the bed began bearing.

CAMBRIDGE, MASSACHUSETTS.

THE YELLOW-FRUITED FORM OF *ILEX OPACA* AT NEW BEDFORD, MASSACHUSETTS.—Attention was called in RHODORA of December, 1900, to a new station for the rare yellow-fruited *Ilex verticillata*, Gray. During the recent holiday season a collector of evergreens

for decorative purposes brought to New Bedford a few branches of a yellow-fruited Holly, *Ilex opaca*, Ait. The fact was called to my notice, when I immediately sought out the farmer who had found the tree and engaged him to pilot me to the spot. It was not an easy task to find it in the deep woods of oak and pine with snow lying on the ground, but persistent effort at last revealed the object of our search. It was a slender, symmetrical tree, 18 to 20 feet in height, with the trunk five inches in diameter at the ground. The abundant clusters of berries were looser, and the bright, yellow fruit somewhat smaller than the typical form.

The "Illustrated Flora" mentions the variety as rarely occurring, and it is quite remarkable that the two rare varieties of the same genus should be found but a few miles apart. — E. WILLIAMS HERVEY, New Bedford, Massachusetts.

A NEW VARIETY OF *JUNCUS TENUIS*.

M. L. FERNALD.

(Plate 23.)

DURING the past July Mr. Emile F. Williams found at Van Buren, Aroostook County, Maine, a singular rush, unlike any of the forms recognized in America. In the light of Dr. Wiegand's excellent paper¹ and the authenticated specimens in the Gray Herbarium and the herbarium of the New England Botanical Club, Mr. Williams's plant is confidently placed with *Juncus tenuis*. In its loose broad sheaths with prolonged white scarious auricles and in its greenish flowers it is clearly a form of this species, but in its inflorescence it is very unlike any described variety.

The short conspicuously secund branches of the inflorescence suggest at first *J. secundus*, Beauv., but in that the branches of the inflorescence are very ascending or even incurved, and the bract is distinctly shorter. In Mr. Williams's plant, on the other hand, the very short branches are widespreading or recurved and much exceeded by the bracts. In the secund arrangement of its flowers the plant approaches also Dr. Wiegand's *Juncus tenuis*, var. *anthelatus*; ♀

¹*Juncus tenuis* Willd. and some of its North American Allies; Bull. Torr. Club, xxvii. 511-527.

but that is a coarser form with very large loose inflorescences and scattered flowers, while the Van Buren plant is low and slender with small inflorescences of closely approximate flowers.

The plant, here proposed as a new variety and dedicated to Mr. Williams who was first to call attention to its peculiar habit, is not confined to the St. John valley, as identical specimens were collected at Edgeworth, Malden, Massachusetts, by the late Wm. Boott in 1853. Its characters, clearly shown in the plate generously prepared by Mr. Charles E. Faxon, are here briefly summarized:

JUNCUS TENUIS, Willd., var. **Williamsii**. Very slender, 2 to 4 dm. high: bracts mostly 2 or 3, at least one overtopping the narrow oblong (2.5 to 8 cm. long) inflorescence: branches mostly wide-spreading or slightly recurved, 1 to 2 cm. long, closely 3-6-flowered, strongly secund: mature capsule equalling the perianth.—MAINE, Van Buren, July 19, 1900 (*Emile F. Williams*): MASSACHUSETTS, Edgeworth, Malden, July 19, 1853 (*Wm. Boott*, in Herb. N. E. Bot. Club).

EXPLANATION OF PLATE 23.—*Juncus tenuis* var. *Williamsii*: fig. 1, portion of an original specimen from Van Buren; fig. 2, mature capsule, enlarged; fig. 3, sheath with prolonged scarious auricle, enlarged. *J. tenuis*: fig. 4, inflorescence of a plant from New Haven, Connecticut. *J. tenuis*, var. *anthelatus*: fig. 5, inflorescence of an original specimen from Hartford, Maine.

A COLONY OF WAIFS OF THE HELIANTHOIDEAE.—In 1896 I discovered in an old field in Oxford, Connecticut, *Helianthus rigidus*, Desf., and *H. grosse-serratus*, Martens. In 1897 or 1898 I found *Heliopsis scabra*, Dunal, close at hand, and as I passed through the field in August of this year my eye was caught by an unfamiliar flower, which proved to be *Lepachys pinnata*, Torr. & Gray. The field was under cultivation some eight or ten years ago, and has since been used mostly as a pasture. Seeds of these western species were doubtless brought here with grain, but it seems remarkable to find a group of four so nearly related plants so far from their range and persisting through so long a time. Of the four *Helianthus rigidus* seems most at home, although the most western in its natural range. It grows over an area of nearly half an acre in several patches and seems to be increasing from year to year. *H. grosse-serratus* grows mixed with the last in four small patches and seems to be decreasing, as is also *Heliopsis scabra*, of which there are not more than a dozen plants. Of the *Lepachys* I have seen but a single clump of ten flowering stalks.—E. B. HARGER, Oxford, Connecticut.

NOTES ON THE EMBRYOLOGY OF SOME NEW ENGLAND ORCHIDS.

R. G. LEAVITT.

SPIRANTHES CERNUA. — In the December *RHODORA* I gave a brief account of polyembryony in this species. The embryos (Fig. 1) are of vegetative origin and ecologically are to be classed with bulbils and tubers. It is noteworthy that the apparatus of fruit and seed-coats, which serves most plants for the dissemination of embryos sexually derived, is here put to the same use in the interests of the apogamous off-spring. The plant combines in this process the swiftness of seed-dispersal with the elsewhere slow, but always sure, methods of vegetative propagation.



Fig. 1

Heretofore *Coelebohyne ilicifolia* alone has been known to produce adventive embryos without the stimulus of pollination. With *Spiranthus cernua*, therefore, I took pains to determine whether pollen was needed to make the embryos grow. I took up a plant, which had lately sent up a flower-spike, on which only the six lower flowers were open. From these I drew out the pollinia. The remaining eight flowers were opened and their pollinia were removed with forceps; the pollinia in every case were examined under a lens and found to be whole. In several cases the membranes surrounding the pollen-masses were brought away with the pollen. The potted plant was then placed under a bell-jar in the laboratory, where it was kept until the seeds were ripe; with the result, as already reported, that multiple embryos formed as abundantly and grew to the same dimensions in all the pods as they do upon plants in the fields.

Among orchids polyembryony of this type is known only in this species, I believe. Below will be noted instances in other New England species of the doubling of the embryo in the embryo-sac in the manner already described for several orchidaceous plants.

When the sac and egg-apparatus develop normally, and the egg undergoes fertilization — a condition that I found in a few plants of this species — the resulting embryo within a very few days becomes

large enough to fill the sac. On all sides the tissues are then pushed back. Below — or towards the exostome of the seed — the end of the embryo, where the suspensor should be found, is rounded and is covered only by the remains of the enveloping cells (Fig. 2).

At the opposite extremity a recession of the sac is filled with dense protoplasm in which a large and perfect nucleus (*en*) is always present.

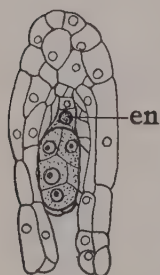


Fig. 2

The question of the origin of this nucleus is of great interest just at the present time. For those who have not freshly in mind the history of the various nuclei of the embryo-sac of angiosperms, it should be said that at a certain stage four nuclei are found at either end of the sac. One nucleus from each of these groups then advances to the centre of the sac. These are termed polar nuclei.

They ultimately fuse and the resulting body is the so-called endosperm nucleus, ordinarily to be distinguished by its size and position. The three nuclei remaining at the base of the sac are the antipodals. One of the three at the micropilar end becomes the egg-nucleus; the other two are the nuclei of the synergides. After the inception of the embryo, in most plants the endosperm nucleus divides repeatedly, giving rise to the cells of the endosperm the function of which is to nourish the embryo.

Recently Nawaschin, followed by other observers, has discovered that in some plants at least, one of the male nuclei from the pollen tube takes part with the polars in the formation of the endosperm nucleus. Both male generative cells are thus functional, one combining with the egg, one with the polars. Nawaschin calls this *double fertilization*. The discovery is regarded as one of the most interesting of recent years.

In following the fertilization of some tropical orchids Nawaschin has come to the conclusion that there is no fusion of polars and male; that though the three come to lie in a close group, no actual union occurs. This appears to Nawaschin to explain the absence of endosperm in Orchidaceae.

Strasburger long ago described the nuclear changes in the embryo-sac of several native orchids, and specifically affirmed the fusion of the polars. Now he has reexamined his material and concludes that the extra spermatic nucleus takes part with the

polars in the production of a true endosperm nucleus. In the orchids which he has investigated, therefore, lack of endosperm cannot be charged to the failure of double fertilization.

In normally fertilized *Spiranthes cernua*, after fertilization, a well-formed nucleus of at least twice the size of a single antipodal is to be seen near the middle of the sac. It is this which is pushed to the base of the sac by the growth of the embryo.

In one of my preparations (by paraffine) may be seen a sac containing a very young embryo, the synergides near by, the antipodals in their places, and toward the centre of the sac two nuclei about the size of the antipodals, lying in contact, while between and touching both is a much smaller, deeply staining nucleus presenting the usual appearance of the spermatie nuclei of orchids. Here we have the origin of the large central nucleus clearly indicated.

These facts lead me to suppose that in *Spiranthes cernua* polar fusion and double fertilization give rise to a true endosperm nucleus. Nevertheless, no endosperm is formed. The nucleus remains at the end of the sac where probably, by vitalizing the protoplasm around it, it assists in passing along nutriment to the embryo.

(To be continued.)

THE AMES BOTANICAL LABORATORY,
North Easton, Massachusetts.

NOTEWORTHY PLANTS OF SOUTHEASTERN CONNECTICUT,—II.

C. B. GRAVES.

To the observations reported in a former paper (RHODORA, i, 67) the following may be added as a further contribution to our knowledge of the plant life along the southern borders of New England.

Panicum Atlanticum Nash — Franklin, Old Lyme.

Panicum Bicknellii Nash — Lamb's Hill in Norwich.

Panicum Addisonii Nash — Sandy terrace near Pachaug Pond in Griswold.

Panicum Eatonii Nash — Borders of ponds and marshes both fresh and brackish.

Eleocharis diandra Chas. Wright — Shores of Connecticut River and

of Selden's Cove in Lyme. Originally collected near Hartford, this species has subsequently been found (in one of its forms) along the Connecticut at stations in Massachusetts, New Hampshire and Vermont (see RHODORA, ii, 60). This new station thus extends its known range in New England quite to the mouth of the Connecticut River.

Scirpus Torreyi Olney — with the preceding growing abundantly; in good condition by July 10. Probably its first record in the state.

Carex tetanica Schk. — One station in Waterford. This rare species, otherwise known in New England only from northern Maine and from Berkshire County, Massachusetts, is to be expected in western Connecticut.

Carex ptychocarpa Steud. — With the last. A southern species known from only two more northern stations, one in Rhode Island, the other in Purgatory Swamp, Norwood, Massachusetts.

Sagittaria subulata (L.) Buchenau — Shore of Selden's Cove in Lyme; first reported from this station many years ago by Miss Thompson of East Haddam. This is apparently the only known station in New England.

Sagittaria heterophylla Pursh. — Shores of Connecticut River and Selden's Cove in Lyme; also in Norwich (Setchell).

Sagittaria Engelmanniana J. G. Smith — Waterford, in peat bogs. Not previously recorded from Connecticut, although known from Long Island and from Cape Cod.

Commelina communis L. — Occasionally seen in gutters and waste places, New London.

Rumex altissimus Wood — One plant in waste ground, New London; has been observed now for three seasons.

Rumex Patientia L. — A few plants near Selden's Cove in Lyme. This and the preceding species are apparently seldom seen in Connecticut.

Prunus Alleghaniensis Porter. — Specimens of a plum which Mr. Fernald has identified as this species were collected by the writer in 1898 and 1899 in Lisbon, where it was found growing sparingly on sandy bottoms along the Quinebaug River. This species has been known hitherto only from central Pennsylvania.

Linum medium (Planch.) Britton — Sandy roadsides, Waterford and Old Lyme. This would seem to be one of those plant forms which are more easily distinguished in the field than in the herba-

rium. As seen by me the expanded flowers are distinctly larger and paler than those of *L. Virginianum* L.

Vaccinium Pennsylvanicum angustifolium (Ait.) A. Gray — A small patch of this northern form was found in 1899 near the edge of Great Cedar Swamp, Voluntown. In New England ordinarily confined to the higher mountain summits.

Lonicera coerulea L. — Abundant in Voluntown, especially in the wet sphagnous meadows bordering the cedar swamps. It here fruits very freely, the delicious berries which much resemble blueberries in flavor being fully ripe and loading the bushes on June 17, 1899.

Rhamnus cathartica L. — Lebanon, a few plants by roadsides.

Ilex laevigata Gray — Cedar swamps in Ledyard, North Stonington and Voluntown.

Barbarea praecox R.Br. — Cultivated ground at Scotch Cap, Waterford, 1899 and 1900. Apparently its first record in New England.

Silene dichotoma Ehrh. — Waste ground, New London, 1898.

Cerastium semidecandrum L. — Abundant in old fields near Niantic River, East Lyme. Formerly unknown north of New Jersey.

Spiraea ulmifolia Scop. — Sparingly escaped to a roadside thicket near Cedar Grove Cemetery, New London.

Aster Schreberi Nees — Wooded banks, Montville and Norwich.

Chrysanthemum Balsamita L. — Escaped to the roadside near farm houses at two places in East Lyme and one in Groton. One of these stations was discovered about ten years ago, and the plant was then well established. A resident of one of these houses when asked the name of this plant called it "beaver's tongue."

NEW LONDON, CONN.

THE SIXTH ANNUAL WINTER MEETING OF THE VERMONT BOTANICAL CLUB was held at the University of Vermont on the 25th and 26th of January. Fourteen papers were presented. Among the more important of which was that of President Brainerd, entitled: The present Status of Vermont Botany. It was an able discussion of the flora as presented in the new catalogue of Vermont plants. In outlining the work of the Club in the future, he maintained that plants in the field in their ecological and physiological relations should receive more attention. Much interest was manifested in the account of the finding of a plumose variety of *Asplenium ebeneum* Ait. by Mrs. Frances B. Horton of Brattleboro. Dr. E. A. Burt gave a detailed description of *Tremella mycetophila* Pk. and stated his reasons for transferring it to *Exobasidium mycetophilum* (Pk.) Burt.

Prof. L. R. Jones discussed the poisonous properties of the equisetums and ferns. Although they were undoubted cases of horses being poisoned by *Equisetum*, the evidence showed the ferns free from any such stigma. The minor discussions centered about the new catalogue and were of unusual interest. The midsummer field meeting is to be held in Rutland on the 2nd and 3d of July.—C. D. HOWE, Univ. of Vermont.

IN THE FOUNDATIONS OF BOTANY¹ Mr. Bergen follows in the main the plan of his earlier text-book, which the present attractive volume replaces. The amount of subject-matter is increased by new experiments and observational work, and new chapters on Ecology and on Types of Cryptogams (the latter by Mr. A. B. Seymour). With a new Key and Flora, describing nearly 700 species of common spring plants, the whole matter covers some 670 pages.

Improvements in the teaching directions and many new and interesting exercises show the author's gain in the technique of botanical teaching in the years since the former book appeared. The new sections are particularly good reading, and the text as a whole has gained in vivacity and the interest due to breadth of view combined with concrete treatment. The illustrations, while not entirely original, are well selected and well executed. Mr. Bergen has given the schools a most serviceable text-book.

In case the school authorities allot but a half year to botany the good sense of the teacher (and school committee) should safeguard the pupil from the only danger which besets him in the case of a book so attractive—the danger of being hurried through a great number of observations without time for proper comprehension.—L.

As it is now customary in binding scientific periodicals to include the covers, thus making them a permanent part of the volume, we shall be glad to furnish a correctly centered cover to replace that of our February issue which was by accident badly trimmed.

¹Ginn & Co., Boston, 1901.



C. E. Faxon del.

JUNCUS TENUIS, var. WILLIAMSII, n. var.

